P.T.A

List

OF THE

OFFICERS

OF THE

GEOLOGICAL SOCIETY OF LC

ELECTED FEBRUARY 1847.

President.

Sir Henry T. De la Beche, F.R.S. & L.S.

Vice-Presidents.

Sir P. Grey Egerton, Bart. M.P. F.R.S.
Charles Lyell, jun., Esq. F.R.S. & L.S.
Professor Owen, F.R.S. & L.S.
Rev. Prof. Sedgwick, F.R.S.

Secretaries.

William John Hamilton, Esq. M.P.
John Carrick Moore, Esq.

Foreign Secretary.

C. J. F. Bunbury, Esq. F.L.S.

Treasurer.

John Lewis Prevost, Esq.

COUNCIL.

J. S. Bowerbank, Esq. F.R.S.
Charles Darwin, Esq. M.A. F.R.S.
Hugh Falconer, M.D. F.R.S. & L.S.
Prof. E. Forbes, F.R.S. & L.S.
G. B. Greenough, Esq. F.R.S. & L.S.
William Hopkins, Esq. F.R.S.
Leonard Horner, Esq. F.R.S. L. & E.
Robert Hutton, Esq. M.
G. A. Mantell, LL.D. F.
Sir R. I. Murchison, G.C
Samuel Peace Pratt, Esc
D. Sharpe, Esq. F.L.S.
H. E. Strickland, Esq. M
S. V. Wood, Esq.

Assistant-Secretary.

James Nicol, Esq. F.R.S.E.

Curator.

Mr. J. De C. Sowerby, F.L.S.

Notice to the Binder.

Insert pp. 46*a*, 46*b* in No. 10, after p. 46 in No. 9.

Insert Table of Fossils to Dr. Fitton's Section at Atherfield, and pp. 325*—328* in No. 12, after p. 328 in No. 11.

Cancel Plates x. and xi. in No. 11, and insert in their place Plates x. and xi. given with this No.; also, insert Plate xx. after Plate xix in No. 12.

themselves of the works contained in the Society's Library, will be considered as a sufficient compensation for the expense incurred, which, from the uncertain and peculiar nature of the work, has, as they have already observed, exceeded the estimated sum.

The Council also have to announce that they have found it necessary to revise the rules and regulations respecting the borrowing of books from the Library. They trust that a perusal of these regulations, inserted in every volume of the Library, will convince the Society that they have been framed with a view to suit the convenience of, and afford every facility to readers desirous of consulting and of borrowing works from the Library, while at the same time the Council have endeavoured not to overlook the duty imposed upon them of providing for the due preservation of the property of the Society.

They have much satisfaction in announcing, that, in consequence of duplicate copies of the following works having been presented to the Library by the following Members, viz.

Agassiz's Poissons Fossiles, by Mr. Horner;
Sowerby's Mineral Conchology, by Mr. Greenough;
Goldfuss's Petrefacta Germaniæ, by Mr. Greenough;
Lindley's Fossil Flora, by Mr. Bowerbank;
Cuvier's Ossemens Fossiles, by Sir R. Murchison;
De Koninck's Animaux Fossiles, by Mr. D. Sharpe;
D'Orbigny's Palæontologie Française, by Mr. Moore;

there will now be one copy constantly in the Library, while another will be allowed to circulate among the Members.

The Council have to announce the completion of the second volume of the Quarterly Journal of the Geological Society, and the publication of the first part of Vol. III., in conformity with a resolution of the Council of the 2nd Dec. 1846, that the publication of the Journal should be continued for another year on the same plan, terms and conditions as during the past year; for although the Council confidently hope that this form of publication will be continued, they have not considered it desirable to decide on its publication except from year to year; they are unwilling to dismiss this subject without expressing their regret that so many of the Members of the Society do not take the Journal, as in consequence of the sale being limited their means of publishing the Transactions are materially crippled. The Index to Vol. IV. of the Proceedings has also been published.

The Council have also to announce the publication of the third part of Vol. VII. of the Transactions; and with reference to the heavy amount of stock of former volumes on hand, they have resolved, in order to promote its sale, that the parts published previous to June 1840 (viz. Vol. II. pt. 2, to Vol. V. pt. 3 inclusive) shall, after reserving fifty copies in the hands of the Society, be offered to the Fellows and the public at one-half of the present prices respectively. They trust that the effect of this measure will be to disseminate the contents of these volumes more widely, and to give a greater stimulus to the pursuit of geological investigations.

General Statement explanatory of the Alteration in the Number of Fellows, Honorary Members, &c. at the close of the years 1845 *and* 1846.

Number of Compounders, Residents and Non-residents, December 31, 1845			810
Add, Fellows elected during former years, and paid in 1846	Residents.... 2 Non-residents. 1	— 3	
Fellows elected, and paid, during 1846	Residents.... 17 Non-residents. 12	—29	
		—	32
			842
Deduct, Compounder deceased		1	
Residents „		2	
Non-residents „		6	
Resigned		13	
		—	22
Total number of Fellows, 31st Dec. 1846, as above..			820

Number of Honorary Members, Foreign Members, and Personages of Royal Blood, December 31, 1845....	73
Add, Foreign Member elected in 1846................	1
Total as above	74

Number of Fellows liable to Annual Contribution at the close of 1846, *with the Alterations during the year.*

Number at the close of 1845		250
Add, Elected in former years, and paid in 1846		2
Elected and paid, during 1846		17
Non-residents who became Residents		10
		279
Deduct, Deceased	2	
Resigned	13	
Compounded	6	
Became Non-resident	5	
	—	26
Total as above		253

DECEASED FELLOWS.

Compounder (1).

Charles Worthington, Esq.

Residents (2).

John Bostock, M.D. | Sir J. S. Sebright, Bart.

Non-residents (6).

John Cole, M.D.
Rev. Richard Hennah.
Charles T. Kaye, Esq.
John Norris, Esq.
The Dean of Windsor.
Thomas Winter, Esq.

Specimens of Crinoidal remains; presented by the Earl of Enniskillen, F.G.S.

Spiral appendages of a Spirifer in Chert, from Ashford; presented by James Tennant, Esq., F.G.S.

Pecten and *Pentacrinites* in Sandstone; presented by W. Richardson, Esq., F.G.S.

Specimens of Hastings Sand from near Tunbridge; presented by Messrs. Prestwich and Morris, Fs.G.S.

Specimens of *Unio* from the Iron Mines of Caermarthenshire; presented by W. L. Wrey, Esq., F.G.S.

Cast of Head and Paddle of a new species of *Plesiosaurus*; presented by S. Stutchbury, Esq., F.G.S.

Foreign Specimens.

Specimens of Copper Ores from South Australia; presented by F. S. Dutton, Esq.

A series of Fossils from the Nummulite Limestone of India, and Fossil bones, &c. of Ruminants from Scinde; presented by Capt. Vicary and General Sir C. Napier.

A portion of an Elephant's tooth from the Island of Gozo; presented by Jas. Smith, Esq., F.G.S.

Leptæna euglypha, from the Mendip Hills, and a Fossil Conus from Malta; presented by A. Majendie, Esq., F.G.S.

Coal from Formosa; presented by Sir G. Staunton, Bart., F.G.S.

Specimens of Rocks of Round Island and Serpent's Island, north of the Mauritius; presented by Capt. Beaufort, R.N., Hon. Mem. G.S.

Collection of Upper Silurian Fossils from Gothland, and Lower Silurian Fossils from Scania, &c.; presented by Sir R. I. Murchison, V.P.G.S.

Sigillaria from the Coal Measures of South Joggins, Nova Scotia; presented by Charles Lyell, Esq., F.G.S.

Collection of Fossils and Rocks from South Australia and Van Diemen's Land; presented by J. B. Jukes, Esq., F.G.S.

Collection of Tertiary Fossils from Koomie, Smyrna, Samos, &c.; presented by Lieut. T. A. B. Spratt, R.N., F.G.S.

Fossil Frogs from the neighbourhood of Bombay; presented by G. Clarke, Esq.

Fucoids in Quartzose Sandstone, Table Mountain, Cape of Good Hope; presented by Mr. Geddes Bain.

Specimens of Fish and Crustaceans from Juni Bay, Mount Lebanon, and Fossils and Minerals from the Dead Sea; presented by Capt. Newbold, R.N.

Silicified Ostrea and Wood, and Minerals from Georgia; presented by George White, Esq.

Cast of Skull of *Sivatherium Perimense*, from Perim Island; presented by A. Bettington, Esq., F.G.S.

Beaufort, Capt. R.N., Hon. Mem. G.S.
Bettington, A., Esq., F.G.S.
Binney, E. W., Esq.
Bowerbank, James, Esq., F.G.S.
British Association for the Advancement of Science.

Calcutta Journal, Editors of.
Catullo, Prof. T. A.
Chemical Society of London.
Clarke, G., Esq.
Colby, Major-Gen., F.G.S.
Cumming, Rev. J., F.G.S.

Dana, J. D., Esq.
D'Aoust, M. V.
Darwin, Charles, Esq., F.G.S.
Daubeny, Prof., M.D., F.G.S.
De Koninck, M. L.
De la Beche, Sir H. T., For. Sec. G.S.
D'Orbigny, M. Alcide, For. Mem. G.S.
Dunker, D. W.
Dutton, F. S., Esq.

Enniskillen, Earl of, F.G.S.

Faraday, Michael, Esq., F.G.S.
Forbes, Prof. E., F.G.S.

Geneva Society of Nat. Hist.
Geological and Polytechnic Society of the West Riding of Yorkshire.
Geological Society of France.
Gilliss, Lieut. J. M.
Grantham, R. B., Esq., F.G.S.
Greenough, G. B., Esq., F.G.S.
Grey, Right Hon. Earl.
Griffith, Richard, Esq., F.G.S.
Gumprecht, Dr. T. E.

Hausmann, Prof. J. F. L., For. Mem. G.S.
Hennah, Rev. W. V.
Horner, L., Esq., Pres. G.S.

Institution of Civil Engineers.
Ireland, Lord Lieutenant of.

Jobert, M. A. C.
Johnson, A. K., Esq., F.G.S.
Jukes, J. B., Esq., F.G.S.

Kelaart, E. F., M.D., F.G.S.
Kutorga, Dr. S.

Lee, John, LL.D., F.G.S.
Lee, H. M., Esq.
Leeds Philosophical Society.
Linnæan Society.
Logan, W. E., Esq., F.G.S.
London Geological Journal, Editor of the.
London Institution.
Lyell, Charles, Esq., F.G.S.

Majendie, A., Esq., F.G.S.
Mantell, G. A., LL.D., F.G.S.
Michelin, H., Esq.
Microscopical Society.
Modena Society.
Morris, John, Esq., F.G.S.
Moore, J. C., Esq., Sec. G.S.
Müller, Herr John.
Murchison, Sir R. I., F.G.S.

Napier, Gen. Sir C.
Newbold, Capt.
New York Lyceum of Nat. Hist.
Noble, Daniel, Esq.
Nyst, M. P. H.

Orlebar, A. B., Esq.

Philadelphia Academy of Natural Science.
Phillips, Prof. J., F.G.S.
Pictet, M. F. J.
Pilla, Herr L.
Prestwich, Josh., jun., Esq., F.G.S.

Reeve Brothers, Messrs.
Rennie, G., Esq., F.G.S.
Richardson, W., Esq., F.G.S.
Rose, Prof. Gustav, For. Mem. G.S.
Royal Academy of Berlin.
Royal Academy of Brussels.
Royal Academy of Munich.

After the Balloting Glasses had been duly closed, and the lists examined by the Scrutineers, the following gentlemen were declared to have been duly elected the Officers and Council for the ensuing year:—

OFFICERS.

PRESIDENT.

Sir H. T. De la Beche, F.R.S. and L.S.

VICE-PRESIDENTS.

Sir P. G. Egerton, Bart., M.P., F.R.S.
Charles Lyell, jun., Esq., F.R.S. and L.S.
Prof. Owen, F.R.S. and L.S.
Rev. Prof. Sedgwick, F.R.S.

SECRETARIES.

William John Hamilton, Esq., M.P.
John Carrick Moore, Esq.

FOREIGN SECRETARY.

C. J. F. Bunbury, Esq., F.L.S.

TREASURER.

John Lewis Prevost, Esq.

COUNCIL.

J. S. Bowerbank, Esq., F.R.S.
C. J. F. Bunbury, Esq., F.L.S.
Charles Darwin, Esq., F.R.S.
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Sir P. Grey Egerton, Bart., M.P., F.R.S.
Hugh Falconer, M.D., F.R.S. and L.S.
Prof. E. Forbes, F.R.S. and L.S.
G. B. Greenough, Esq., F.R.S. and L.S.
William John Hamilton, Esq., M.P.
William Hopkins, Esq., F.R.S.
Leonard Horner, Esq., F.R.S. L. & E.
Robert Hutton, Esq., M.R.I.A.
Charles Lyell, jun., Esq., F.R.S. and L.S.
G. A. Mantell, LL.D., F.R.S. and L.S.
John C. Moore, Esq.
Sir R. I. Murchison, G.C. St.S., F.R.S. and L.S.
Prof. Owen, F.R.S. and L.S.
Samuel Peace Pratt, Esq., F.R.S. and L.S.
John Lewis Prevost, Esq.
Rev. Prof. Sedgwick, F.R.S.
D. Sharpe, Esq., F.L.S.
H. E. Strickland, Esq., M.A.
S. V. Wood, Esq.

INCOME.

	£.	s.	d.	£.	s.	d.
Balance at Banker's, January 1, 1846....	338	5	2			
Less composition to be invested..........	31	10	0			
	306	15	2			
Balance in hands of Clerk, Jan. 1, 1846 ..	8	7	8			
				315	2	10
Compositions received	157	10	0			
Do. at Banker's, as above	31	10	0			
				189	0	0
Do. received in December after Consols closed				31	10	0
Arrears of Admission Fees...............	23	2	0			
Arrears of Annual Contributions	31	10	0			
				54	12	0
Admission Fees of 1846..........................				233	2	0
Annual Contributions of 1846				771	4	6
Dividends on 3 per Cent. Consols				93	3	9
Sale of Transactions				129	10	3
Sale of Transactions in separate Memoirs............				26	7	1
Sale of Proceedings				8	3	0
Journal, Vol. I., Publisher's allowance on sale				7	11	0
Sale of Journal, Vol. II..........................				198	1	5
Library:						
Sale of Catalogue...................	3	10	0			
Donation from Sir T. Phillips	5	0	0			
				8	10	0
				£2065	17	10

We have compared the Books and Vouchers presented to us with these Statements, and find them correct.

Signed, JOHN PRESTWICH, Jun. } AUDITORS.
Feb. 3, 1847. SAMUEL PEACE PRATT, }

Estimates *for the Year* 1847.

INCOME EXPECTED.

				£.	s.	d.
Account due by Messrs. Longman and Co. in June				65	7	7
Arrears (See Valuation-sheet)				90	6	0
Ordinary Income for 1847 estimated:						
Annual Contributions (240 Fellows)				756	0	0
Admission Fees:	£	s.	d.			
Residents (13)	81	18	0			
Non-residents (12)	126	0	0			
				207	18	0
Dividends on 3 per Cent. Consols				97	10	0
Sale of Transactions, &c.				100	0	0
Sale of Quarterly Journal				300	0	0
				£1617	1	7

EXPENDITURE ESTIMATED.

				£.	s.	d.
Bill due to Messrs. R. and J. E. Taylor				57	3	6
General Expenditure:	£.	s.	d.			
Taxes and Rates	35	11	4			
Fire Insurance	9	0	0			
	30	0	0			
	15	0	0			
New Furniture	15	0	0			
Fuel	55	0	0			
Light	25	0	0			
Miscellaneous House Expenses	50	0	0			
Stationery	25	0	0			
Miscellaneous Printing	15	0	0			
Tea for Meetings	30	0	0			
				284	11	4
Salaries and Wages:						
Assistant Secretary	120	0	0			
Librarian and Curator	130	0	0			
Clerk	100	0	0			
Porter	80	0	0			
House Maid	33	4	0			
Occasional Attendants	12	0	0			
Collector	30	0	0			
				505	4	0
Library, Binding and Additions				50	0	0
Museum				30	0	0
Diagrams at Meetings				25	0	0
Miscellaneous Scientific Expenditure				10	0	0
Publications, Quarterly Journal				460	0	0
„ Transactions				100	0	0
„ Proceedings, Index to Vol. IV.				18	0	0
				1539	18	10
Balance in favour of the Society				77	2	9

sur l'Ecosse,' a most remarkable work to have been accomplished in so short a time by one individual, a young man, especially considering the state of the science at that time. He was then, too, labouring under the disadvantage of having been imbued with the system of Werner, at that time exclusively taught by Professor Jameson: "J'ai suivi," he says in his introduction, "dans mon travail les principes de son école." But in justice to my excellent friend Professor Jameson, it must be said, that although he then taught an erroneous creed, he inspired his scholars with a devotion to science which led to their conversion to a sounder faith, as the same devotion to the cause of sound Geology afterwards led their master; and in the same sentence from which I quote the above words, his attached pupil says, "J'ai mis à profit les intéressantes leçons de M. Jameson." But Dr. Boué was too acute and able a man to continue long fettered by the dogmas of any school; he read the volume of nature himself, without the aid of the Freyberg Professor as an interpreter, and he had the merit of being one of the first who pointed out to continental geologists the unsoundness of the Wernerian hypotheses. Humboldt frequently alludes to this first work of our distinguished Foreign Member, in his 'Essai sur le Gissement des Roches,' and always with approbation; and even the severe MacCulloch speaks of it with comparative respect.

Dr. Boué next brought out various Memoirs on the Geology of France and Germany, the fruits of his researches during several summers occupied in exploring these countries; and in these he was the first to maintain that the Muschelkalk and Quadersandstein of the Germans were not identical with any English formations, but distinct beds. These memoirs were embodied in his 'Geognostical Picture of Germany.' He undertook the difficult and dangerous task of exploring European Turkey, which occupied him several years, the results of which he published in an elaborate work, which gives the first authentic account of the geology of this little-known region. His various journeys were undertaken at his own expense: he never accepted any public appointment, although the Chair of Geology at Geneva was offered to him some years ago through the influence of Professor De la Rive and others. Dr. Boué was one of the founders of the Geological Society of France in 1830; he and M. Elie de Beaumont were its first Secretaries; he was Vice-President in 1834, when he gave a "Resumé des Progrès des Sciences Géologiques pendant l'Année 1833," which occupies the whole of the fifth volume of the Bulletin of the Society; and in 1835 he was elected its President. He is now resident at Vienna, pursuing his geological researches with unabated ardour. I received a letter from him three days ago, in reply to that in which I announced to him the award of the Wollaston Medal; he regrets his inability to be present to receive it, and he adds, that he is deeply sensible of the unexpected honour that has thus been conferred upon him.

On receiving the Medal, Sir RODERICK MURCHISON replied as follows:

ceous strata is nearly completed, and forms in itself one of the finest and most extensive palæontological monographs extant. The descriptions therein given are full and well drawn up, and the figures which accompany them are unrivalled for beauty of execution. It is in the hope of contributing towards the continuation and completion of this great undertaking, that the Council now offer to M. d'Orbigny such assistance as lies within their means. Important as is the Cretaceous section of the 'Paléontologie Française,' the continuation of the Oolitic division, as yet only commenced, would be, if possible, even of more consequence to our science in England. A monograph of recent and fossil Crinoidea is another of M. d'Orbigny's works, which has as yet proceeded but a short way, and I scarcely need say how valuable such an essay would be, if complete. The memoirs of this distinguished naturalist upon the fossils of South America, on the secondary fossils of Russia, and many others of minor extent, all bear testimony to his talents and industry, and to his ardent zeal for science. Few living naturalists have sent forth such a mass of valuable work, in the descriptive and iconographical departments of Palæontology; and, perhaps, none but himself would have the courage to contemplate such a gigantic undertaking as the 'Paléontologie Universelle des Coquilles et des Mollusques,' combined with a complete history of existing species, recently announced, and even commenced by M. Alcide d'Orbigny.

Sir Henry de la Beche said in reply:—I entirely concur in all the remarks which you, Sir, have just made respecting the merits of M. Alcide d'Orbigny, and the importance to our science of promoting, by all the means in our power, the publications in which he is engaged; and I highly value the privilege, which my official position in the Society gives me, of being the channel for such a communication to M. d'Orbigny as the present.

After the other proceedings had been completed, and the Officers and Council had been elected, the President proceeded to address the Meeting.

ANNIVERSARY ADDRESS OF THE PRESIDENT,

LEONARD HORNER, Esq., V.P.R.S.

Gentlemen,—I have again the satisfaction of being able to congratulate you on the prosperous state of the Society. At no period has it been in a condition of more effective usefulness; our numbers are greater than at any former Anniversary; we never had a larger proportion of our Fellows actively engaged in various departments of geological science; our finances are in so sound a state, that we live within our income, and are able to publish the papers read at our meetings quickly and with ample illustrations; our collections of

of the place of the Plymouth limestone in the British Series; but he *did* know the near resemblance of several species of his Plymouth fossils to those of the mountain limestone. More than this, he had traced the line of Plymouth limestone into White Sand Bay on the Cornish side of the great estuary, and he had done this by help of fossils. For the mass of limestone thins off, and you can only follow its line by help of some very insignificant reddish calcareous bands with a few fossils (especially encrinites) which he identified with those in his Plymouth limestone. This was really good geological work; and remember it was done before 1819, when he was becoming old and had not the leisure for travelling:—remember too the existing state of knowledge. In 1836 I followed the fossil bands from Plymouth to Fowey, Veryan, &c., and thence to the slates north of the Lizard Serpentine. I was in fact only following out what was a corollary from the work of Hennah before 1819. In 1836 De la Beche had not touched the south-west coast of Cornwall, so my work was original in one sense; but it was, I say, suggested by Hennah's work, and I only took the subject up where he had left it off."

The two eminent persons I have mentioned lived to an advanced period of life; but he whose loss I have now to speak of has been taken from us in the vigour of manhood.

Mr. Charles Turton Kaye was born in London in 1812, and from school went to the East India Company's College at Hayleybury in 1829, where he distinguished himself and gained the Classical Medal at his first examination in 1830. In the spring of 1831 he proceeded to India, having obtained an appointment in the civil service, in the presidency of Madras. In the College of Fort St. George he obtained the thousand-pagoda prize for proficiency in the native languages. He was at first employed in the revenue department, and was shortly afterwards appointed Assistant to the Accountant-General of Madras; but in 1838 he received the more important appointment of a Judge at Cuddalore, on the Coromandel coast. Hitherto his attention had been more directed to literature than to science, and accidental circumstances appear to have led him to geological studies. In conjunction with his friend Mr. Brooke Cunliffe, also resident at Cuddalore, now a Fellow of this Society, he examined in 1841 a neighbouring district, which is remarkable from containing fossil wood in great abundance, and where they collected a considerable number of other organic remains. They afterwards obtained many specimens of fossils from a limestone in the neighbourhood of Pondicherry and Trichinopoly. Mr. Kaye came to England on leave of absence in the spring of 1842, bringing the collection with him which he presented in his own name and that of Mr. Cunliffe to this Society. He drew up a short memoir, describing generally the structure of the country from which he had obtained the fossils, which was read on the 29th June 1842; and that memoir, together with two reports, the one by Sir Philip Egerton "On the Remains of Fishes," the other by Professor E. Forbes "On the Fossil Invertebrata of the Collection," have, as you

so carefully examined this region, that he not only produced an excellent description of its physical geography, relative heights, and mineral constitution, but also developed the ascending series of sedimentary deposits through each great period. The second part of this work, published in 1836, was accompanied by a general geological map of Poland and the North Carpathians, illustrated by local maps, plans and sections; and when I state that this general map contains fifty distinct colours or signs, indicating the various sedimentary strata, and seven colours for the eruptive rocks, besides distinct indications of all the mines, I may convey some idea, however inadequate, of the indefatigable industry of this author.

In the publication of this work, M. Pusch had the merit of fully appreciating the dependence of correct geological results on an accurate acquaintance with fossils. Not contented with simply employing the old generic names of Schlotheim, which when he was educated were considered to be adequate to the explanation of the age of rocks, he mainly grounded his reasoning and inductions on the principle of "strata identified by their specific fossils;" and in drawing a parallel between the Polish formations and those which had been well-established in other countries, he specially appealed to the geology of England and Wales. It would be unreasonable to expect perfection in a work prepared under the great obstacles to which I have alluded, and which, from there being no German press in Poland, was necessarily printed in another kingdom. But notwithstanding his insulated state, M. Pusch clearly laid down the geological outlines of the kingdom of Poland and the adjacent provinces of Podolia and Gallicia, and instituted numerous comparisons which have stood the test of subsequent inquiries. Thus, for example, after describing the transition limestone of Podolia, he suggested that its overlying red sandstone being older than the carboniferous rocks, must be of the age of the Old Red Sandstone of England; and although we are now informed by Sir R. Murchison * that some of the transition limestones which Pusch had compared with the limestone of Sweden are not, like the latter, of Silurian, but of Devonian age, still it is evident that our deceased Associate very nearly reached the truth by the above-mentioned comparison.

In working out the relations of the secondary rocks, M. Pusch devoted a considerable portion of his time to the description of that enormously thick and widely spread series of sandstone, conglomerate, shale, and impure limestone, which constitutes the northern and eastern flanks of the Carpathian chain, under the name of "Carpathian Sandstone," and in this effort he was ably seconded by the Austrian geologist, the late M. Lill von Lilienbach. Indicating its various members upon his map by eight distinct colours and letters, M. Pusch considered the whole group of Carpathian sandstone (though with doubts) to be an intervening mass between the Lias and the cretaceous strata; or in other words to represent the lower part of the Jurassic rocks, whilst he associated with its upper portion the saliferous deposits of Wielieczka, &c. Now, although most of

* Russia and the Ural Mountains, vol. i. p. 39.

on lithological analogies, or even upon the apparent order of superposition; since it is now well known, that formations frequently lie in inverted positions in those parts of the world wherein the rocks have undergone violent disturbances.

This triumph of palæontology over all other evidences is indeed the peculiar feature of modern geology; and M. Pusch was one of the labourers in the field who have been conspicuous in achieving it. His work on the Palæontology of Poland, published in 1837, was a valuable addition to all that had preceded it, and is much more copious and detailed than the contemporary inquiries of Dubois de Montpereux and Eichwald, who severally described the organic remains of certain parts only of the same country.

It was for these contributions to physical geology and palæontology, that in the year 1841 M. Pusch was elected a Foreign Member of our Society; and when it is recollected that he achieved these results in a region remote from those persons who could best aid him, and gave to us an original Map of the subsoil of a previously unclassified country, I may truly say, that few of our honorary associates have had stronger claims upon our grateful remembrance. For the last few years of his life, M. Pusch had been almost exclusively employed in the tedious and oppressive minutiæ of the administration of the Polish Mines, particularly in the direction of the Coal works on the eastern or Polish limit of the Silesian coal-field.

Progress of Geology.

I will now endeavour to bring before you an outline of some of the more prominent features in the onward movement of the science we cultivate, during the last year. That progress is so rapid, that while it is gratifiying in one sense, it causes a feeling of disappointment almost amounting to despair; for it outstrips the efforts of the most active and industrious to keep pace with, leaving a consciousness that, even within our own domain, if we are to know anything well, we must remain ignorant of much that we should be glad to be acquainted with. And so connected are the various departments of the wide field of Geology, that we are thus constantly doomed to feel the disadvantage of our imperfect acquaintance with other branches of our subject, in working out that which is the special object of our study.

The separate works and the memoirs contained in periodical publications by the geologists of Europe and of the United States of North America have been so numerous, that I might fill my pages by giving only a summary *Catalogue Raisonnée* of the subjects treated of; but as an address so composed would be equally wearisome to me to write and to you to listen to, I have thought it better to follow the same course I did last year, by dwelling on some of those subjects of general interest which are most attractive to myself, and to which consequently I have paid most attention. I will however first advert to some of the larger and more general works.

Among the most valuable of these, I am disposed to name first the

closely printed pages an amount of reading equal to two-thirds of his Journal. In his first work we had the outlines of these geological observations, but in that recently published we have the outlines filled up with most valuable details, together with many new facts, general observations and deductions, which will be read with much profit by every geologist. In the sequel of this Address, I shall allude more particularly to some of the more striking features of this work.

We received last spring a valuable work from our distinguished Foreign Member, M. Elie de Beaumont—his 'Leçons de Géologie Pratique.' It is an important publication, as giving us the views and opinions of one of the most eminent geologists of France up to a late period, for these Lectures were delivered only three years ago. He informs us that they were given orally, but taken down in short-hand, and revised by himself for publication. Such of you as are not already acquainted with the work will readily believe that a Course of Lectures by so able, so accomplished, and so experienced a geologist, must contain much that is interesting and valuable; and those who seek for minuteness of detail and amplitude of illustration will not be disappointed.

He tells us that he took the *Agenda* of Saussure, published half a century ago at the end of the fourth volume of the 'Voyages dans les Alpes,' as the basis of his plan, but that the present more advanced state of the science had made it necessary for him frequently to leave his guide. Nevertheless, he says,—and it is a proud homage to the genius and sagacity of the great Swiss geologist,—the facts since collected have scarcely ever led him to controvert Saussure, for that philosopher "possessed in an eminent degree the instinct and the presentiment of truth." At the conclusion of his first Lecture he pays another tribute to the great master whom he justly holds up as an example to the pupils he is instructing, in the following terms: "When we read the 'Agenda' with attention, we are surprised how appropriate the greater number of the questions are to the present time. The 'Agenda' are at once the most judicious and the most stimulating guide to observation which the geologist can follow. All that is wanting is to complete them, to extend them, to modify them in some particulars; to establish certain relations between facts less insulated now than they were in his time; and there is perhaps no way in which Geology can be presented to us in a manner more interesting and more instructive. It is that which I shall endeavour to follow in this Course, in which it will be my aim to present known facts in such a way as is most proper for conducting to facts yet to be discovered*."

This last year has also supplied us with a work long wanted, a 'Manual of Chemical and Physical Geology,' by Dr. Gustav Bischof, Professor of Chemistry in the University of Bonn, already well known to us by several interesting chemico-geological researches in the neighbouring volcanic region of the Eifel; and particularly by his work entitled 'Physical, Chemical, and Geological Researches on the

* Page 44.

such a community of character as to constitute an epoch in time generally, and that it is in this sense we are to understand the pliocene, miocene, and eocene periods respectively. This view may be confirmed by the accumulation of a widely-extended and multifarious body of evidence; but some of the principal causes of the extinction of existing species, and of the introduction of new species, are of a kind that might have come into operation in one portion of the globe, while other parts remained unchanged by similar causes; therefore the synchronism of formations in distant parts of the globe cannot be conclusively determined by evidence that is in its nature inconstant. This leads us naturally to inquire, what the circumstances are on which the distribution and habits of different species of mollusca depend.

Professor E. Forbes has shown, that the distribution of marine animals is determined by three great primary influences, and is modified by others that may be termed secondary or local. The primary are, climate, composition of the sea, and depth: the secondary are, the nature of the sea-bottom, that is, whether it consist of sand or rock, be gravelly or weedy; tides and currents, and the influx of fresh water. It is generally admitted by geologists, that at all periods down to our own times, the surface of the earth has been subject to extensive elevations and subsidences; that plains and lofty mountains have risen where formerly there was sea, and that plains and mountains have subsided and been covered with deep water. It is evident that such elevations and depressions, producing variations in the relative proportions of sea and land, and not only in the extent but in the elevation of the land, must have caused great changes in atmospheric temperature, in the temperature of the sea, in the depths of water, in sea-bottoms, in the direction of currents, and in the influx of fresh water, on different parts of the superficies of our earth, and even on the same parts at different times. But such alterations in the proportions of land and sea could not be synchronous over the whole earth, nor is it probable that in two distinct areas they would be alike in amount or in kind.

Let us, for example, suppose two parts of the ocean (A and B) far distant from each other, under such similarity of condition as to temperature, depths of water, sea-bottom, &c., as to be favourable to the existence of the same or representative species of mollusca; of littoral species, of those inhabiting zones of moderate depth and of deep sea species; let us further suppose earthy deposits going on in each part, and inclosing the remains of the dead mollusca that lived on the rocks and sands and amidst the groves of fuci of its bottom. Let us now suppose subterranean action so to raise the bottom of the part A as to cause shallow water above it: immediately, or soon after, the mollusca capable of existing only in deep water would perish and become extinct in that part, others fitted for shallow water would begin to prevail, and newly-directed currents, caused by the altered form of the land, might bring other species, and the remains of these several new species would, in their turn, be inclosed in the deposits going on in the shallow sea. Let us suppose the number of

branches of the river being 187 miles. The fall from the first cataract to the sea is only two inches in a mile *, and M. Elie de Beaumont states that the bed of the river at Cairo, which is sixteen miles above the head of the delta, is 16 feet 4 inches above the Mediterranean, which gives a fall of 1·9 inch in a mile †.

According to Mr. Lyell, the deposit of the Mississippi "consists partly of sand originally formed upon or near the banks of the river and its tributaries, partly of gravel, swept down the main channel, of which the position has continually shifted, and partly of fine mud slowly accumulated in the swamps. The further we descend the river towards its mouth, the finer becomes the texture of the sediment ‡." A large portion of this alluvial deposit, together with the fluvio-marine strata now in progress, near the mouth, is intermixed with much vegetable matter, derived from the prodigious quantity of drift-wood floated down every summer during the freshets. "In excavating at New Orleans, even at the depth of several yards below the level of the sea, the soil of the delta contains innumerable trunks of trees, layer above layer, some prostrate, as if drifted, others broken off near the bottom, but remaining still erect, and with their roots spreading out on all sides, as if in their natural position. In such situations, they appeared to indicate a sinking of the ground, as the trees must formerly have grown in marshes above the sea-level §."

The east and west boundaries of the alluvial region, for about five degrees of latitude above the head of the delta, consist of bluffs or cliffs, from 50 to 250 feet in perpendicular height, which continue as far north as the borders of Kentucky, not far below the head of the plain. "They consist in great part of loam, containing land, fluviatile, and lacustrine shells, of species still inhabiting the same country. These fossil shells occurring in a deposit resembling the Loess of the Rhine, are associated with the bones of the mastodon, elephant, tapir, mylodon, and other megatherioid animals; also a species of horse, ox, and other mammalia, most of them extinct species. The loam rests at Vicksburg and other places on Eocene or lower tertiary strata, which in their turn repose on cretaceous rocks." As these bluffs are composed of alluvial and freshwater deposits, we may suppose that they were once overflowed by the river, at a time when the relative level of the Mississippi was very different. During the upheaval of the country, the river may have gradually carried away by denudation large portions of the loam, reducing the alluvial plain to its present level, and leaving bluffs bounding the region from which a large quantity of matter has been removed. Mr. Lyell appears to be of opinion that, in modern times, the levels of the great plain of the Mississippi have been chiefly altered by movements of subsidence, such as those which in 1811–12 gave rise to new lakes and what is called "the sunk country" near New Madrid in Missouri. That it was subsidence rather than upheaval is, he thinks, "established by the fact, that there are no protuberances of upraised alluvial soil projecting above the level surface of the great plain. It

* Newbold, Geol. Proceedings, vol. iii. p. 783.

† Leçons de Géologie Pratique, tome i. p. 476.

‡ Principles of Geology, 7th edit. page 216.

§ Ibid. page 214.

southward. In process of time that sea-bottom, thus formed to a great depth of clay, sand, gravel and boulders, was elevated to the surface, level or unequal according as the elevating force acted with uniform or variable intensity, and formed the land of Central Russia. The incoherent materials, after a long period of repose in the new-formed land, are again subjected to atmospheric agency, broken into smaller fragments or worn down into impalpable mud, to be suspended in water and floated to the mouth of the Volga, or to settle at the bottom of the Caspian in a stratified deposit. There they form a new ground on which mollusca live, whose shells will become buried in the slowly forming stone; and this stone covering a region where we know internal heat to be active, may become metamorphic, and assume a compact or crystalline structure. Thus the same matter which was once a constituent of a granite in the Alps of Scandinavia, after undergoing numberless changes in form and structure, through an incalculable period of time, changes however identical with those which we now see in progress, may be hereafter raised up in Asia as the elements of a schistose rock; in like manner as our oldest sedimentary strata must have been derived from the disintegration of pre-existent granites, or other forms of unstratified rock, of which the land was then composed.

You may probably recollect having read, in the newspapers of the autumn of 1845, an account of a quantity of dust having fallen from the atmosphere on the Orkney Islands; it was also said to have fallen to the thickness of an inch on ships in that part of the North Sea. It was supposed to indicate a volcanic eruption of ashes in Iceland; and the conjecture was proved to be correct; for, on the 2nd of September of that year, the great volcanic mountain of Hecla, after a repose of nearly 80 years, again burst forth. On the same day, a quantity of dust fell on a Danish ship in lat. 61° N., and longitude 7° 58′ W. of Greenwich. It blew at the time strong from the N.W. by W. From this point Hecla is 533 miles distant.

We learn from the work of Mr. Ebenezer Henderson *, that between the years 1004, the earliest record, and 1768 inclusive, there had been 23 eruptions, the intervals varying from 6 to 76 years. Sir W. Hooker in his work on Iceland, writing in 1810, says that the last eruption of lava was in 1766, and that it lasted from the 15th of April to the 7th of September, but that flames unattended with lava appeared in 1771 and 1772, since which period neither fire nor smoke had appeared. Sir George Mackenzie, however, describing his ascent of Hecla in 1810, states that on removing some of the slags at the summit, those below were too hot to be handled, and on placing a thermometer among them it rose to 144°†.

Since the eruption in 1845, the island has been visited by French and German geologists, and we shall no doubt receive ere long a detailed account of their observations. On the 26th of October last, M. Dufrenoy laid before the Academy of Sciences at Paris a letter he had received from M. Descloizeaux, who in company with M. Bunsen had visited Hecla last summer. He mentions a change in the height

...al of a Residence in Iceland. † Travels, p. 248.

exhibits a multitude of small longitudinal and parallel ravines, having often a depth of 5 or 6 metres ($16\frac{1}{2}$ to $19\frac{1}{2}$ feet). The centre of the stream still, in July 1846, contained numerous fumeroles in which were beautiful transparent crystals of muriate of ammonia, and large fibrous masses of the same salt, together with a vast quantity of muriate of iron." The rugged surface here described is, as you are aware, a very usual accompaniment of lava streams, arising from the cooling and subsequent cracking by the heat of the inferior fluid mass, and beneath this fissured crust there might be a continuous stream of homogeneous lava, which in cooling would become columnar, and a cross section of the stream would in that case probably exhibit a mass of basaltic pillars, capped by an amorphous layer, and that surmounted by a congeries of blocks, the fissured surface of the stream, just as we see numerous instances in Auvergne, and in many districts where the older trap rocks have flowed in broad streams. M. Elie de Beaumont, in his very elaborate and interesting researches on the structure and origin of Etna, maintains that, in accordance with M. Von Buch's theory of craters of elevation, the beds composing the nucleus of the central mass of Etna have been raised to their present inclination, from a position approaching nearly to horizontality; and appears to be of opinion that no homogeneous stream of lava could consolidate into stone on a surface having an inclination of more than 7 or 8 degrees*. M. Descloizeaux states, as already mentioned, that in some places the stream from Hecla has an inclination of as much as 25 degrees; but if the parts so inclined are composed only of blocks and scoriæ, if underneath there be not a bed of homogeneous lava, that amount of inclination would not be opposed to the theory of M. Elie de Beaumont. We must hope that the detailed descriptions of the French and German observers will throw much light on the structure of this vast expansion of melted stone. I understand that M. Waltershausen is one of those who went from Germany, and his seven years' study of Etna renders him peculiarly qualified to describe the phænomena and compare them with those with which he is so well acquainted.

In the Proceedings of the Royal Academy of Berlin for December 1845, there is an account of a paper read by Professor Ehrenberg, containing the result of a microscopic examination of the dust that fell on the Danish vessel; and in the Proceedings for May last there is a supplement to that paper, describing his examination of some ashes that had been erupted from Hecla on the day above-mentioned. Translations of these notices are given in the last number of the Quarterly Journal of this Society. In these notices, Professor Ehrenberg identifies the dust that fell on the ship with the ashes erupted from Hecla, and they afford another instance of that very remarkable fact, previously made known to us by the same philosopher, viz. the presence of the siliceous shells of infusoria in ashes ejected from volcanos in many different countries. He found thirty-seven different species of these minute organisms, not one of them decidedly new, and all of them peculiar to fresh water. Fifteen are living forms known to exist at present in Iceland.

* Description Géologique de la France, tome iv. p. 176.

These observations on the temperature of the water are highly curious and important. We have a temperature of 261° of Fahr. at the bottom of a free open column of water, in which thermometers could be suspended on a line dropped from the surface, while it might have been expected that as soon as a film of water at the bottom was raised to a higher temperature, it would ascend, and be replaced by a colder and heavier film, and that thus a constant current would be established throughout the column, until the whole arrived at a temperature of 212°, when ebullition would commence and continue. The pressure of the column of water may perhaps account for the high temperature at the bottom, especially if the free circulation be impeded by the sides of the well not being vertical, and still more by projections in the sides causing contractions of its diameter. But the experiments of M. Donny of the University of Ghent, published in the 17th volume of the Memoirs of the Royal Academy of Sciences and Belles Lettres of Brussels, on the Cohesion of Liquids, may perhaps be considered as throwing some light on this phænomenon of the Geyser. By a series of carefully conducted experiments M. Donny has shown:—

1. That the constancy of the boiling point of water, under the ordinary atmospheric pressure, depends upon its containing a considerable quantity of air;

2. That there is a marked difference between the boiling point of water containing air, and of water freed from air;

3. That a small quantity of air, dissolved in water, is sufficient to attenuate greatly *the cohesion existing between the molecules of the water*;

4. That when water is freed from air, as far as that is possible, the cohesion of the molecules is so increased, that a higher temperature is necessary to overcome it, and that the boiling point is very considerably raised.

M. Donny succeeded in raising the temperature of water so freed of air to 135° Centigrade (equal to 275° of Fahr.), under the ordinary atmospheric pressure, without its exhibiting any symptom of ebullition; showing, that the cohesion of the molecules was nearly equal to the pressure of three atmospheres on water containing air. This is a fact most important to bear in mind in reasoning upon many geological phænomena, particularly those connected with the solution of silica.

The further researches of M. Donny, recorded in the same memoir, appear also to offer an explanation of the violent and intermittent eruptions of the Geyser; for he states that if water deprived of air be exposed to so considerable an increase of temperature as to overcome the force of the cohesion of the molecules, the production of vapour is so instantaneous and so considerable as to cause an explosion. As water long boiled becomes more and more deprived of its air, M. Donny attributes the sudden bursting of the boilers of steam-engines to the same cause.

I. THE WEST IRISH FLORA.—The mountainous districts of the west and south-west of Ireland are characterized by botanical peculiarities, which depend on the presence of a few prolific species of the families *Saxifrageæ*, *Ericaceæ*, *Lentibulariæ*, and *Cruciferæ*, the high lands in the north of Spain being the nearest point on the Continent where these plants are native, especially in the mountains of the Asturias, and the species are all members of families having seeds not well adapted for being wafted through the air across the sea.

II. THE DEVON FLORA.—In the south-east of Ireland and south-west of England, there is a flora which includes a number of species not elsewhere seen in the British Isles, and which is intimately related to that of the Channel Islands and the neighbouring parts of France; and in the Channel Islands they are associated with a number of plants which are not natives of England or Ireland. In the south-east of Ireland, the number of plants of this Gallican type is greatly diminished, while such as are present are species met with also in the south-west of England. This second flora is accompanied by terrestrial mollusca of the same climatal stamp.

III. THE KENTISH FLORA.—In the south-east of England, the vegetation is distinguished by the presence of a number of species common to this district and the opposite coast of France; and the peculiar character of the entomology and that of the pulmoniferous mollusca, including several species, are intimately connected with this flora. It is evidently derived from the north-western provinces of France.

IV. THE ALPINE FLORA.—The summits of our lofty mountains yield a variety of plants not found elsewhere in the British Islands; the species of them are most numerous on the Scotch mountains; they are comparatively rare on those of Cumberland and Wales, diminishing progressively southwards. These alpine plants are all identical with the plants of more northern ranges, as the Scandinavian Alps, where however there are species associated with them which have not been found in the British Islands. In Ireland also, a few of these alpine or sub-alpine plants of Scandinavian origin are found. The fauna of our mountain regions, so far as it is developed, bears the same relation to more northern countries, and the absence of peculiar pulmonifera is as good evidence, in the opinion of our author, as the presence of Scandinavian forms of insects.

V. THE GENERAL FLORA.—This is everywhere present, alone, or in company with the others—is identical as to species with the flora of Central and Western Europe, and may be properly styled *Germanic*. "Every plant universally distributed in these islands is Germanic; every quadruped common in England, and not ranging to Ireland or Scotland. The great mass of our pulmoniferous mollusca have also come from the same quarter. Certain botanical and zoological peculiarities are presented by the eastern counties of England. In every case we find these to depend on Germanic plants and animals arrested in their range. The number of species of the Germanic type diminishes as we go westwards, and increases

statement of the author's views as to the mode of migration of the alpine flora, which we find when he treats of that of the other floras. He tells us that the plants of this flora could not have been inhabitants of the ancient west of Europe, but of Scandinavia. "The alpine floras of Europe and Asia," he says, "so far as they are identical with the floras of the Arctic and Sub-Arctic zones of the old world, are fragments of a flora which was diffused from the north, either by means of transport not now in action on the temperate coasts of Europe, or over continuous land which no longer exists." But he had already stated, that during the glacial epoch, when Scotland and Wales, and part of Ireland, received their alpine flora and a small portion of their fauna, they were groups of islands in an ice-bound sea; and that in an after-state of things these islands were upheaved and converted into mountains, and the plants of the colder epoch survived only on the mountain regions which had been so elevated as to retain climatal conditions similar to those which existed when those regions were low ridges or islands in the glacial sea. Thus the only modes of migration, according to this view of a group of islands, must have been by currents or by the transporting agency of icebergs; and from what he states (p. 351), in speaking of the origin of the alpine floras of the Alps and Carpathians, and some other mountain ranges, it is evident that, though not directly expressed, an iceberg is the mode of transport that is chiefly in the author's mind in that part of his essay. Icebergs have been seen partially covered with alluvial soil, on which plants were growing. Are we therefore to suppose, that the alpine flora was transferred from the land now called Scandinavia to that now called Britain, by such icebergs as chanced to carry plants with soil sufficient to preserve their vitality, and as chanced to be stranded on the islands? This mode of transmission appears to have been felt to be unsatisfactory and inadequate by the author, for towards the conclusion of the essay we find the following passage:—"The phænomena of the glacial formations, the peculiarities in the distribution of the animals of that epoch, and in the relations of the existing fauna and flora of Greenland, Iceland, and Northern Europe, are such as strongly to impress upon my mind, that the close of the glacial epoch was marked by the gradual submergence of some great northern land, along the coasts of which the *littoral* mollusks, aided by favouring currents, migrated, whilst a common flora became diffused over its hills and plains. Although I have made icebergs and ice-floes the chief agents in the transportation of an Arctic flora southwards, I cannot but think that so complete a transmission of that flora as we find in the Scottish mountains was aided perhaps mainly by land to the north, now submerged." I am inclined to the opinion, that this last view of the author, the former existence of land towards the north pole, from which there was a continuous communication with the land of our island, is the more probable hypothesis; and many phænomena of the northern drift, especially the difficulty of conceiving any other source for the origin of the vast mass of detrital matter, water-worn stones and boulders, which are found in

the idea of a separate creation of the same series of Mammalia in and for a small contiguous island cannot be entertained; and that the idea of their having swum across a tidal current of sea twenty miles in breadth is equally inadmissible.

I have thus endeavoured to trace the successive geological changes, the upheavals and subsidences of the land, which by strong evidence, botanical and zoological, have been shown to have occurred in this western part of Europe during the more modern of the tertiary periods. But we have not yet traced the more recent changes which Professor Forbes points out in this essay, up to the historical period. We have seen that most of our existing plants and animals can boast a direct lineal descent from ancestors that flourished long before man set foot on these islands, probably before the creation of the human race; certainly before the formation of the German Ocean, or the English and Irish Channels. These seas have great inequalities of depth, but in some places the soundings are as much as nearly 100 fathoms. They were probably formed by the double and concurrent operation of subsidences of the land, and by the wearing action of tides and waves on other parts of the land, cracked, fractured, and loosened as it probably would be by these subsidences. We know that the sea has worn away large tracts of land within our own experience, and that lands on which forests of existing trees grew, have subsided below the level of the sea, on many parts of our coasts. "The formation of the German Ocean and Irish Sea, and new lines of coast, events calling new influences into play, introduced the existing population of our seas. Part of our glacial testacea had been extinguished, part retired to more congenial arctic seas, and a few disappeared from the coasts of Europe, while they continued inhabitants of the shores of America. A considerable number, however, returned to the seas of their ancestors, where they became and remain the associates of numerous forms, some newly called into being to people the new-formed seas, some coming with favouring currents from the warmer seas of the south. Among the latter were a number of forms which had not always been strangers to the British seas. During the genial times preceding the glacial epoch, more than fifty species of testacea, inhabitants at present of our seas, lived in them whilst the Crag beds were in process of formation, but disappeared under the chilly influences of the sub-arctic epoch which succeeded."

On this post-pliocene plain, this upheaved bed of the glacial sea, there must have existed extensive freshwater lakes, from the relics we find of them. In Ireland and the Isle of Man, there are numerous basins of freshwater marls resting on depressions of the upheaved glacial sea-bed, containing shells of existing testacea, along with entire skeletons and many detached bones and horns of the extinct gigantic Irish Elk, the *Megaceros Hibernicus*, which in the opinion of Professor Owen was the contemporary in our islands of the Rhinoceros, Mammoth, and other extinct mammalia, during the period of the formation of the newest tertiary freshwater fossiliferous strata. These freshwater marls are overlaid by peat with its included ancient forests, so that the time when the Megaceros lived was anterior

From that point there is a shallowing of the water towards Ireland to 100, 80, and 67 fathoms, and within ten miles of Cape Clear there is still a depth of 54 fathoms. A denudation to such depths is inconceivable, but a subsidence not only to that but to much greater depths is perfectly conceivable. If, as is probable, the subsidence was gradual, then the action of the waves and of currents, for a short time at least, would come into play, while the water was still comparatively shallow, especially if the subsidence was accompanied by earthquakes or other internal forces, causing fissures and otherwise breaking up and loosening the land. Professor Forbes is of opinion, that all the operations which brought about a change of climatal conditions were gradual. He states (p. 401) that "all the changes before, during, and after the glacial epoch appear to have been gradual and not sudden, so that no marked line of demarcation can be drawn between the creatures inhabiting the same element and the same locality during two proximate periods." We may also infer that subsidence was the chief cause of the formation of the English Channel, St. George's Channel, and the German Ocean. At the entrance of the English Channel, there is a depth of from 56 to 70 fathoms, and the mid-channel shallows from thence to 28 fathoms off Beechy Head. In the distance from Dungeness to Dover, and from Boulogne to Calais, the sea-bottom is very uneven, the depth of water varying from 10 to 30 fathoms. The great inequalities in the sea-bottom, over all the region under review, are of themselves a strong argument in favour of subsidence, for it is infinitely more probable that subsidences would be unequal, than that any denuding force would produce such effects. At the south entrance of St. George's Channel there is a depth of 60 fathoms, and between Waterford and St. David's Head the soundings are from 38 to 54 fathoms. Between Dublin and Belfast Lough the soundings from the shore to the mid-channel between Ireland and the Isle of Man are from 20 to 74 fathoms, and opposite the coast of Galloway they deepen to 99 fathoms. In the German Ocean and North Sea the depths are in general not so great; but here too there are great inequalities, the soundings varying from 9 fathoms, within four miles of the shore, to as much as 76 fathoms in some places, the shallowest parts being over the extensive banks that prevail in that ocean, such as the Long Forties, the Long Bank, the Dogger Bank, and the little Fisher's Bank off the coast of Scotland. Our author's theory twice supposes the upheaval of the sea-bottom into land, viz. that of the Miocene and that of the Glacial sea, and subsidences are equally conceivable.

The most extensively continuous tertiary deposit with which we are acquainted, is that of pleistocene age on the eastern side of the southern half of the continent of South America, extending more than 1600 miles northward from Tierra del Fuego, and consisting of the great covering of gravel spread over Patagonia, and of the calcareo-argillaceous deposit that constitutes the soil of the Pampas. 1 as we are indebted to M. Alcide d'Orbigny for the great addi-

having collected round them, when they existed as islets or submarine rocks, at a greater height than the bottom of the adjoining open sea; the cliffs having been subsequently worn during the elevation of the whole country in mass*."

The most remarkable feature to the geologist, of this great Pampean formation, is the vast accumulation of the fossil remains of mammalia which it contains, chiefly herbivorous, generally of great size, and belonging to extinct genera, some even to extinct families or orders,—the Megatherium, Mylodon, Toxodon, Glyptodon, Scelidotherium, Macrauchenia, Megalonyx and Mastodon. "The greater number of them," Mr. Owen tells us, "are referable to the order which Cuvier has called *Edentata*, and belong to that subdivision of the order which is characterized by having perfect and sometimes complex molar teeth, and an external osseous and tessellated coat of mail. The Megatherium is the giant of this tribe†."

Mr. Darwin has given many interesting descriptions of the localities where these fossil bones have hitherto been found; they are all between the 31st and 50th degrees of south latitude; and numerous though the remains already discovered have been, they can form only a very small portion of what lie buried in the deposit; for they have as yet been almost exclusively found in the cliffs and steep banks of rivers. "I am firmly convinced," Mr. Darwin says, "that a deep trench could not be cut in any line across the Pampas without intersecting the remains of some quadruped." The bones occur at all depths, from the top to the bottom of the deposit; he himself found some close to the surface; near Buenos Ayres a skeleton was disinterred from a depth of 60 feet, and on the Parana two skeletons of the Mastodon were found only five or six feet above the base of the deposit.

The theory of the formation of this vast extent of indurated mud and calcareous concretions proposed by M. Alcide d'Orbigny in his 'Travels in South America,' viz. that it was produced by a vast and sudden flood,—a debacle, is shown by Mr. Darwin to be inconsistent with the various phænomena which the deposit exhibits; its structure, its concretions, the horizontal layers of tosca rock, the absence of granite and boulders, all indicating a slow and tranquil deposition,—to say nothing of the improbability of the existence of a mass of fine mud combined with carbonate of lime in a state fit for chemical segregation, ready to be transported by the debacle, and sufficient in amount to cover a space larger than the whole of France. The theory which Mr. Darwin himself suggests appears a very intelligible and probable explanation of the facts he describes. He supposes that the materials of the Pampean formation were derived from the great area of older rocks, igneous and sedimentary, in Brazil and the high country to the north and west that surrounds the plains; that they were transported by numerous streams and rivers and deposited in a vast bay, the former estuary of the Plata, extending into the low country of Banda Oriental and forming a part of the adjoining sea, in the same manner as we have seen that the delta of the Mississippi has been formed. This operation of transport, and deposit of similar materials, ap-

* Page 79. † Owen, Fossil Mammalia, Voyage of the Beagle, p. 15.

power, upon careful examination, pebbles of compact basalt could not be found in the bed of the river at a greater distance than ten miles below the point where the stream rushes over the debris of the great basaltic cliffs forming its shores: fragments of the cellular varieties have been washed down twice or thrice as far." Mr. Darwin is of opinion, that the cause of the rounding of the fragments and the spreading out and levelling of the gravel is to be ascribed to the action of the sea, as it gradually receded from the foot of the Cordillera to the present coast, by the slow upheaval of the land. He admits, however, that it is a problem of great difficulty. "By whatever means," he says, "the gravel formation of Patagonia may have been distributed, the vastness of its area, its thickness, its superficial position, its recent origin, and the great degree of similarity in the nature of its pebbles,—all appear to me well-deserving the attention of geologists, in relation to the origin of the widely-spread beds of conglomerate belonging to past epochs*." It is seen on the coast to rest on horizontal beds of older tertiary strata, which in some places form cliffs from 800 to 900 feet in height: as it is seen in the interior capping terraces formed of deposits containing shells, and as the gravel with its sandy covering is often strewed with recent marine shells, there is no doubt of its belonging, like the Pampean formation, to the pleistocene age; and in all probability they were nearly contemporaneous. In the valley of Santa Cruz, at a distance of 100 miles from the sea, and at an elevation of 1400 feet, the gravel is covered with numerous angular erratic blocks, some as much as 60 feet in circumference. These were described by Mr. Darwin in a paper read in this room, and published in the sixth volume of our Transactions, and he there attributes their position to the transporting action of icebergs, the probable origin of the erratic blocks of Northern Europe.

Elevation of the land.—We know that the land of the western coast of South America has risen considerably in our own time: we have proofs of considerable elevations in the recent period of geological time, when the country was inhabited by man, and we can trace back the continuance of the same operation of subterranean force to far earlier periods, and upon a greater scale, in various parts of that same coast; nor is there wanting evidence to show that there have been partial subsidences of the land within the historical period. But these changes of relative level of sea and land during the pleistocene period are more distinctly seen on the eastern coast: they were described by Mr. Darwin in his 'Journal,' but in his recent work he has gone into far greater details respecting them,—into a minuteness of description that was not admissible in the plan of his 'Journal,' but which is far more interesting and satisfactory to the geologist.

For a space of more than 1200 miles, from the 33rd degree of S. latitude southward, the land has been gradually elevated, as shown by a succession of terraces one above the other, with abrupt escarpments facing the sea, and separated from each other by gently sloping

This On the coast of Patagonia, between Santa Cruz and Port

* Page 24.

* P

western side of the continent during the pleistocene period; that they were unequal in amount at different parts of the coast; and that the action of the subterranean force was intermittent, periods of rest intervening. Shells of the same species as are now living in the shallow waters of the shores of the Pacific, and in the same proportions as to numbers, are met with in the island of Chiloe at a height of 350 feet above the sea, near Concepcion at 625, and even, according to Lieut. Belcher, at a height which he estimated to be 1000 feet. They occur at the latter height near Valparaiso, and although diminished in number, Mr. Darwin found four species in the same locality at an elevation of 1300 feet. "These upraised marine remains occur at intervals, and in some parts almost continuously, from lat. 45° 35′ to 12° S. along the shores of the Pacific, a distance in a north and south line of 2075 geographical miles; and from the similarity in the form of the country near Lima, it is probable they occur there also, which would extend the line to 2480 miles. From the steepness of the land on this side of the continent, shells have rarely been found at greater distances inland than from two to three leagues; but the marks of sea-action are evident farther from the coast; for instance, in the valley of Guasco, at a distance of between 30 and 40 miles*." That the elevations were gradual, is shown by the shells being all littoral, or such as live at very moderate depths; and by their broken condition, and by their becoming more brittle and having a more ancient appearance the higher they are found, they afford evidence that they had formerly been cast up upon a succession of beaches. The escarpments of the successive terraces, on which shells are strewed, in the sinuosities of the valleys that open to the coast, indicate not only gradual upheavals, but intervals of rest. At Coquimbo there are five such terraces, one above another, in a height of 364 feet.

Although they relate to an earlier period of geological time than that now under consideration, I shall pass to some other parts of the work of Mr. Darwin; and I do so the more willingly, because the phænomena he describes, in the account he gives of his examination of that part of the Cordillera of Chile, are connected with great internal movements, analogous to those which have elevated the land near the coast, on both sides of the South American continent, in comparatively modern periods.

That part of the Cordillera which forms the eastern boundary of Chile is not more than about 60 miles wide; and, if we except the volcanic peaks, which occur only at distant intervals, the highest mountains do not much exceed 14,000 feet above the sea. The plain of St. Jago, at their base on their western side, is 2300 feet; that of the Pampas, on the eastern side, 3300 feet in height. "Although I crossed the Cordillera," says Mr. Darwin, "only once by the Portillo or Peuquenes Pass, and only once by that of the Cumbre or Uspallata, riding slowly and halting occasionally to ascend the mountains, there are many circumstances favourable to obtaining a more faithful sketch of their structure, than would at first be thought possible

* Pages 53–57.

crystals of hornblende, with mica, chlorite, epidote and quartz. Where the mica and quartz are abundant, the rock cannot be distinguished externally from granite. A brick-red granite composed of orthite or potash-felspar occurs in the Portillo range, which Mr. Darwin is inclined to think is of newer formation than the rock of which albite is the chief constituent.

After ascending the Peuquenes Pass to a height of 7000 feet, a vast formation of gypseous strata begins to appear. It is partly composed of beds of snow-white hard gypsum with a saccharoid fracture, and partly of a pale brown argillaceous gypsum, highly inclined, and conformable in stratification with those of the porphyritic conglomerate on which they repose. The gypseous beds are covered by a red sandstone, seen in some places to be 1000 feet thick; this again is covered by gypseous beds of equal thickness, and these in their turn are surmounted by a repetition of the red sandstone. Above the latter rock there occurs a black, compact, calcareous shaly rock of vast thickness. From these last strata Mr. Darwin collected two Ammonites, a Gryphæa, a Natica, a Cyprina, a Rostellaria, and a Terebratula, which having been examined by M. Alcide d'Orbigny, were considered by him to belong to the Neocomian stage of the Cretaceous system. Fossils collected in another part of the same formation were pronounced by M. von Buch to indicate a formation intermediate between the limestone of the Jura and the chalk, analogous with the uppermost Jurassic beds forming the plains of Switzerland. The fossils collected by Mr. Darwin were imbedded in the rock at the height of 13,200 feet, and the same beds are prolonged upwards to at least from 14,000 to 15,000 feet above the level of the sea. These strata have been greatly disturbed, dipping both west and east, the remnants of an anticlinal ridge, and they also dip towards the centre of the range.

A similar series of beds occurs on the eastern flank of the Cumbre range, but associated with numerous alternations of porphyritic and felspathic rocks, with all the characters of submarine contemporaneous lavas. The flanks of the mountain are here quite bare and steep, affording a section of a series of strata whose united thickness must be nearly 6000 feet: from the lowest to the uppermost bed of gypsum, it cannot be less than 2000 feet. There is however this important difference between the Cumbre series and that of the Peuquenes, that the limestone, containing the same fossils as that of the Peuquenes which lies there near the top of the series, at the Cumbre lies at the very base of the formation, just above the porphyritic conglomerate—that is, several thousand feet lower in the series; and it forms a stratum 80 feet thick. In the opinion of M. von Buch and M. d'Orbigny, the two formations belong to the same age. Professor Edward Forbes has likewise a strong impression that they indicate the cretaceous period, and probably an early epoch in it; and Mr. Darwin himself is of opinion, that probably the gypseous and associated beds in all the sections belong to the same great formation, and he has denominated it *cretaceo-oolite*. Similar strata have observed farther north in Southern Peru by Mr. Darwin a

rhinoceros, mastodon and aurochs. The country was then also covered to a considerable extent with freshwater lakes, the sites of which are now shown by depressions filled with the detritus in which the bones of these animals were entombed. "Whether discovered in the gravelly detritus or clay on either flank of the Urals, in the high banks of the great streams which respectively flow into Asia and Europe, or in still greater quantities on the sides of the estuaries of the great Siberian rivers upon the glacial ocean, in all cases the mammoths are found entombed in materials which, whether coarse lacustrine shingle near the mountains, or mud and sand at a distance from them, all announce in the most emphatic manner, that these great creatures lived in lands adjacent to lakes and estuaries, in which, during long ages, their bones were interred, and were sometimes carried out to sea and mingled with oceanic remains*."

The present watersheds between Europe and Asia were formed by an increased elevation of the Ural chain, at the time when these animals occupied this eastern land; and their destruction and extinction is ascribed by the author partly to the disturbance of the land by the upheaving forces, but mainly to the change of climate produced by its increased elevation, and its extension towards the north, the low lands of Northern Siberia having been raised above the water, and the shore of the sea consequently thrown much further back within the arctic region. "In the depressions at the very foot of the chain, the mammoth skeletons are broken up, and their bones, together with those of *Rhinoceros*
rudely commingled in the coarse sh
tains or in the clay above it. In pr
into the plains of Siberia, or descen
and the Obe or their affluents, these
are at the same time in much bett
low tracts of Northern Siberia, in
abundant, were then beneath the sea
drifted thither, and possibly for so
montories between the Obe, the Ye
northwards of the ancient ridges
waters and estuaries at the periods w
the Ural, the Altai, and the adjace
the sea†."

The form of the ground where th
that it was deposited after the prese
been to a great extent established, w
for it fills up all the original inequali
in many places exhibit appearances
and cavities, as if by the powerful a
composed entirely of the stony mater
are no boulders of far-travelled ro
twelve feet thick, but there are so
more than fifty feet thickness. I
mass of clay, and this last by peat

* Page 500.

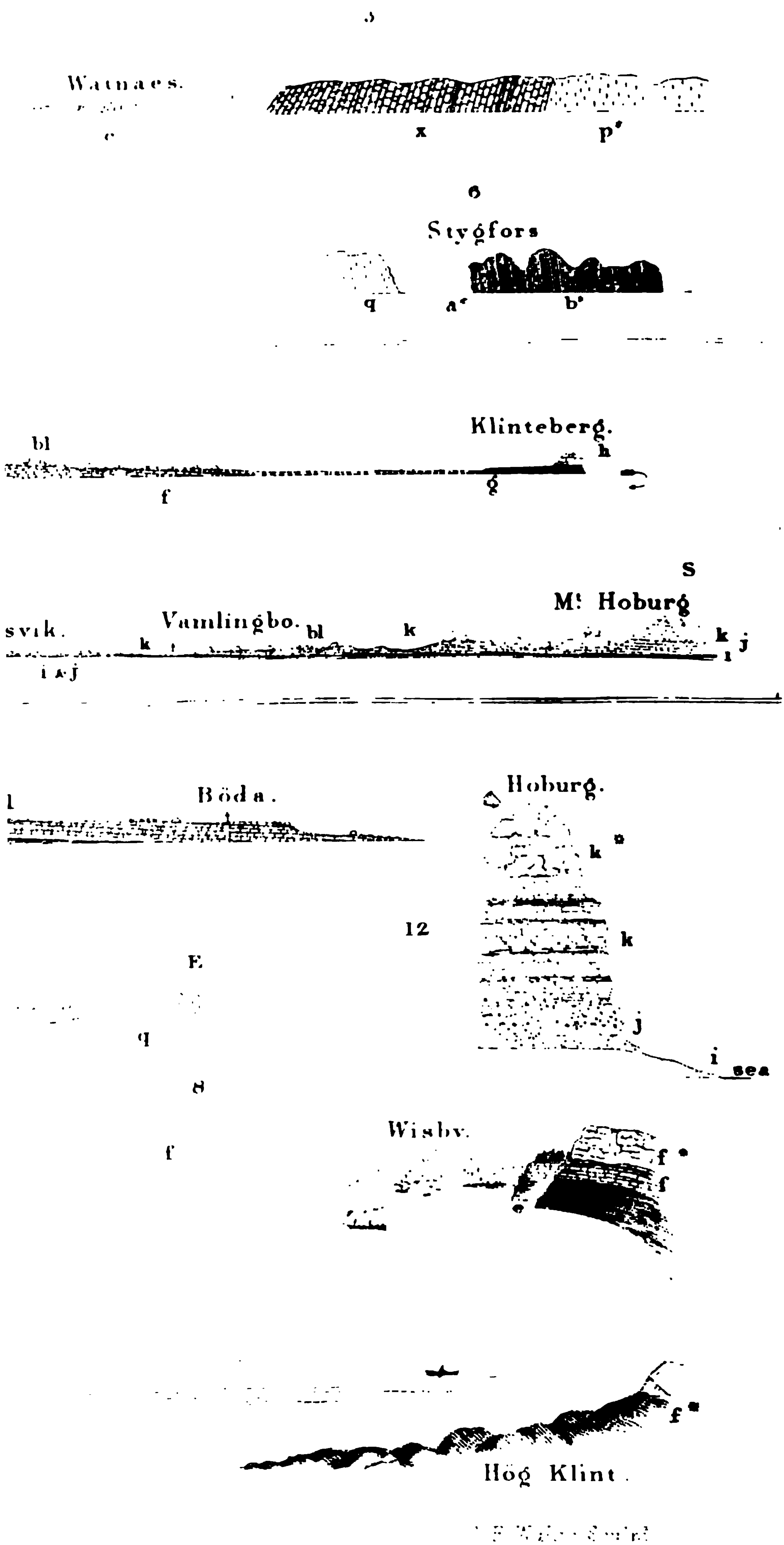
should hitherto have been so little an
so frequented, on the very borders o
and described by so many geologist
Physiques et Lithologiques dans la
refers to it cursorily, but does not ap
any care; Dr. Daubeny himself, in
published in 1826, gives only a gen
half a page; Mr. Lyell in his acco
Naples makes no mention of it*; n
in 1832†, nor M. Dufrenoy in his 'I
caniques des environs de Naples,' p
appears to have been the first geol
Monfina with care; he spent three w
in 1838, and has given an account of
autumn of 1841, 'Ueber die Natur u
kanischen Bildungen,' which, though l
cellent maps. He tells us that M. Pill
subsequently examined the mountain;
volume of the 'Annales des Mines,' w
1841, an account of Rocca Monfina by
mention of the labours of M. Abich,

This mountain lies about 30 miles
above the towns of Teano and Sessa,
base. The summit of the conical hil
the crater, called the *Monte de Santa*
the Aurunci, who successfully resisted
410. As vestiges of the ruined city
Aurunci are mentioned at a very early
clear that there has been no eruption
interior of the crater is covered with
vegetation, as is the central cone; and
late Sir W. Gell observed to him, tha
to whom it was of essential importanc
pasturage for the flocks and herds,
support, would never have selected R
not only if the volcano itself had bee
stone which constitutes the interior of
a state of decomposition as to be cove
abundant crops." We have no means
the volcano was in activity, but this we
have been formed by a sub-aërial erupt
submerged, and therefore that its age i
period in geological chronology when th
in the neighbouring sea were in existe
inhabited by the elephants whose rem
ficial soil.

This volcanic group is continuous
offset of the Apennines, the celebrated *Mons Massicus*, co

* Principles of Geology, ii. ch. 11, 12.

† Geognostische Beobachtungen, published in 1839.


5
Watnaes.
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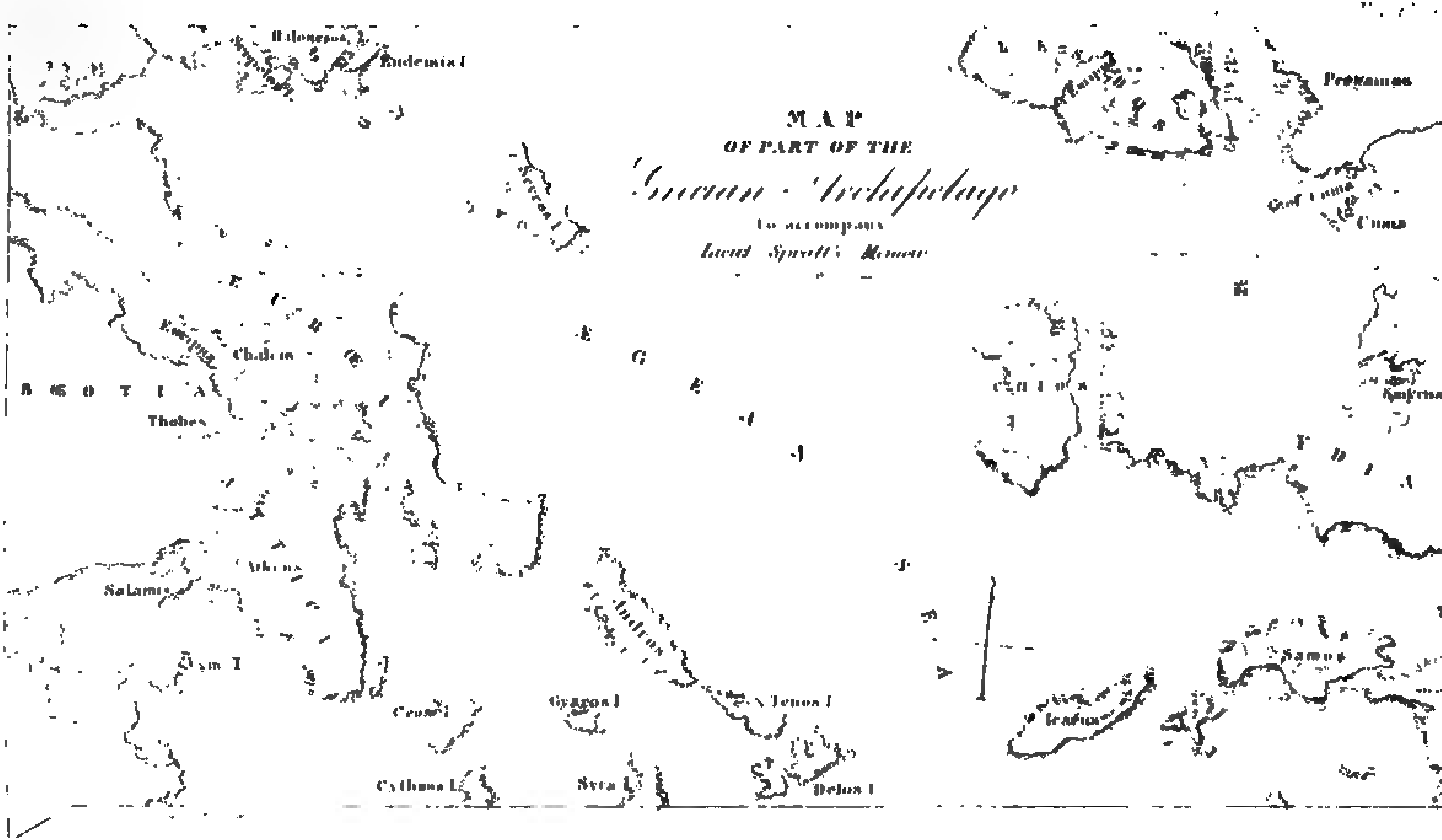
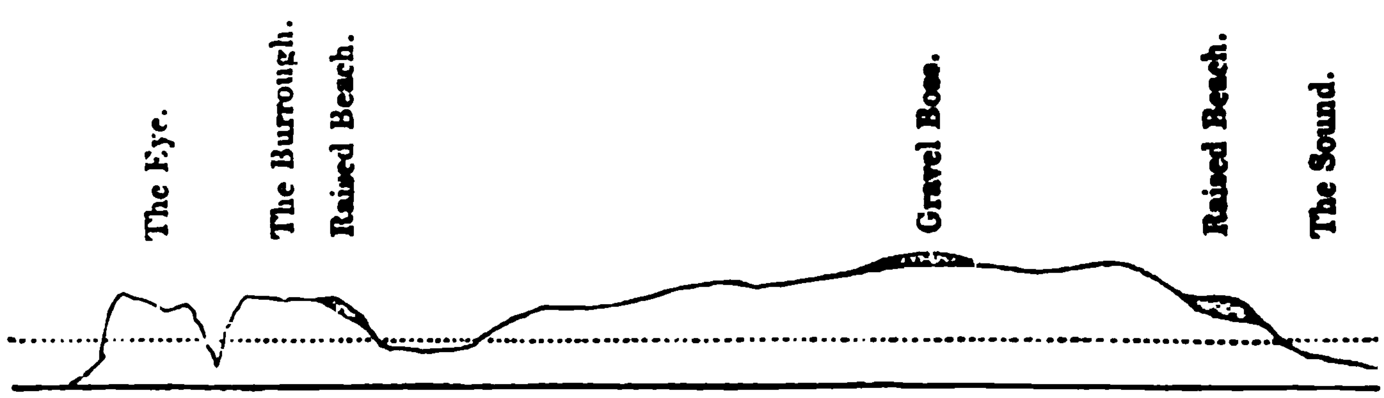

MAP
OF PART OF THE
Grecian Archipelago
to accompany
Lieut. Spratt's Memoir
Pergamus
Chalcis
BŒOTIA
Thebes
Salamis
Andros
Tenos I
Gyaros I
Syra I
Delos I
Samos
Smyrna
Cuma

of course, simply intimates that strata of this age are well developed in the Jura chain) is now so universally made use of by continental geologists, as well as introduced into the writings of some of the most eminent of our own body when treating of foreign rocks, that any attempt to substitute another local name for it would be almost sure to fail. There need be no apprehension that English geologists, adopting the continental term, would run any risk of being robbed of the honour of having first defined the system; for, even should the history of this part of geology be lost, the names of Portland stone, Kimmeridge clay, Oxford clay, &c., which are met with in the writings of all the best foreign authors, sufficiently attest the fact.

Finally, I have only to reiterate the opinion hinted at in concluding the paper to which this is supplementary, that many of the mixed deposits, from the Devonian system upwards, will be found to have originated in "Caspians."

Geologically, the islet of the Calf must be considered simply as a prolongation of the Mull hills, separated from them by a chasm at right angles to the general axis of elevation, and which corresponds, in fact, with the larger chasms, which, when the sea was at a higher relative level, formed channels at Port Erin, Fleshwick and Peel. It rises gradually from the south-western extremity, the northern and

Section (2.)



south-eastern side presenting to the sea precipices to the height of 470 feet, the highest point being at the pile near the ruins of Bushel's

Map of Calf Islet.

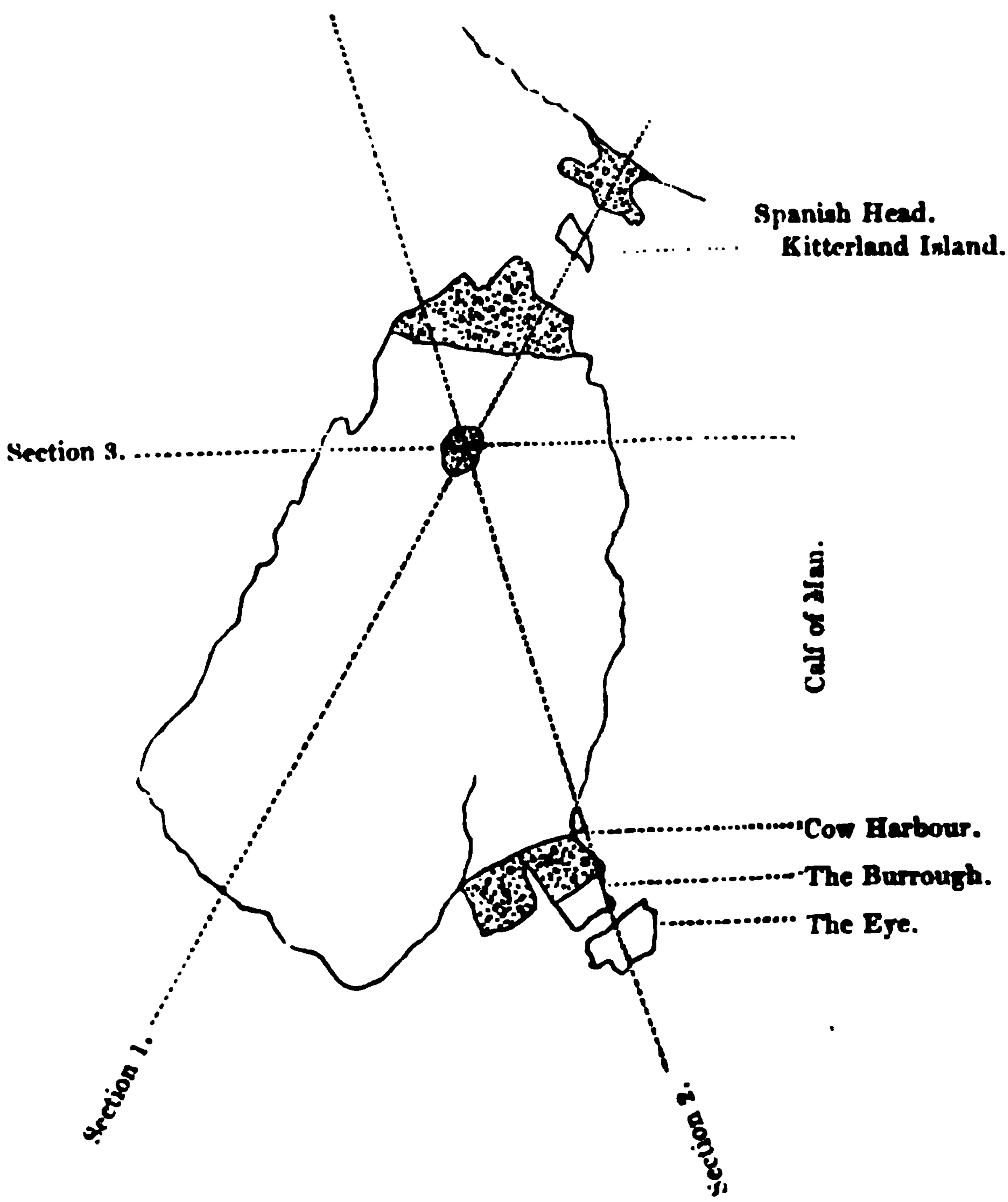


Fig. 4.

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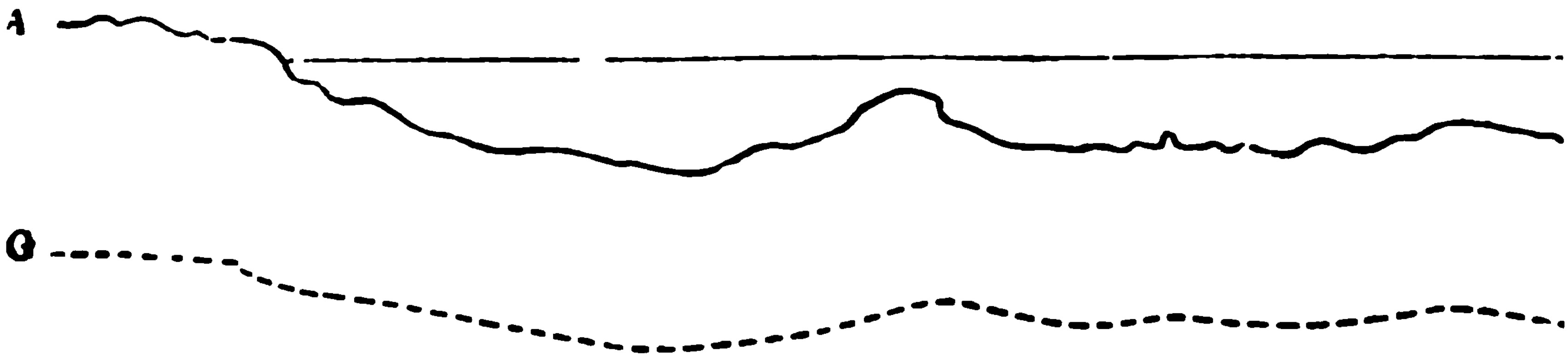

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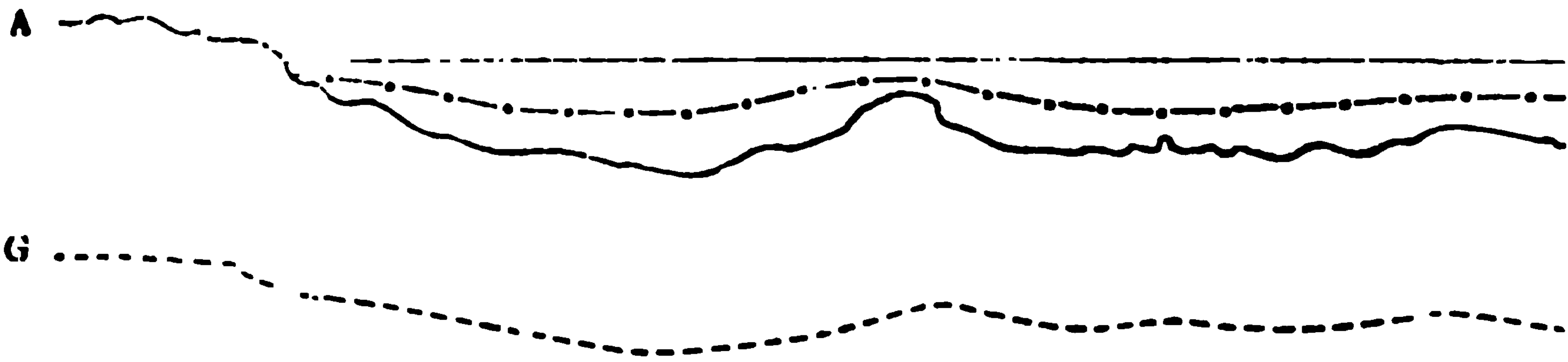

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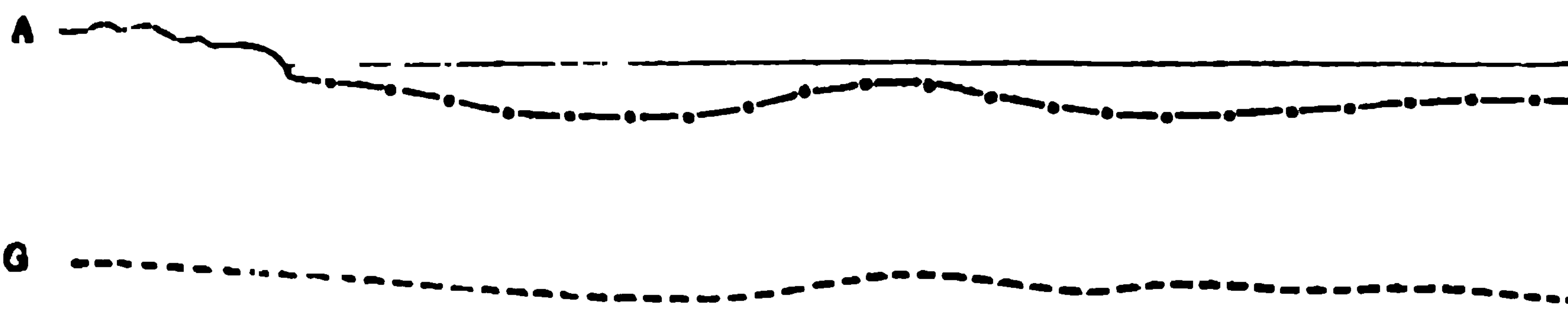
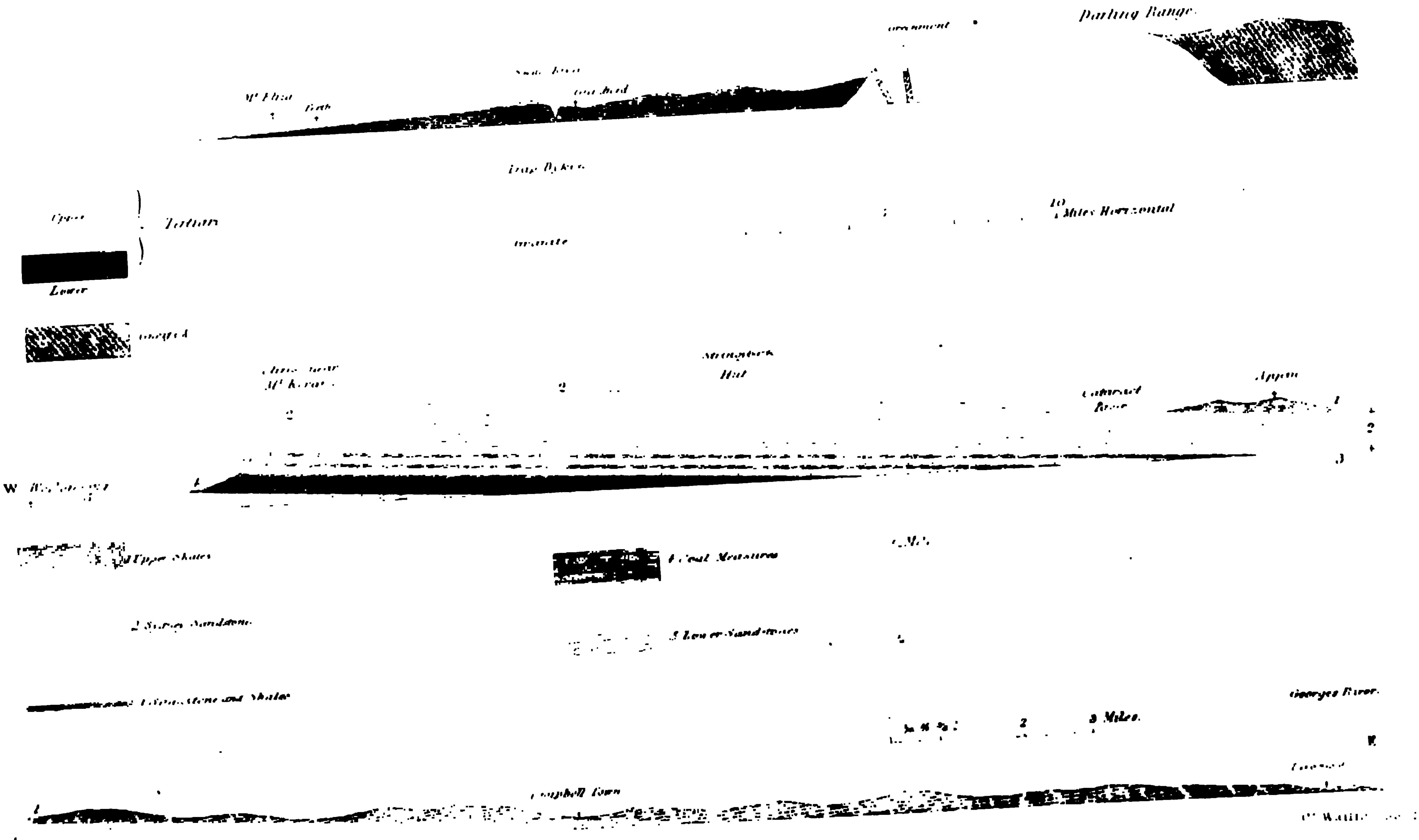


No. 4.

N. B. These woodcuts are stereotypes from *one* block, in the manner described p. 266, Ninth Bridgewater Treatise.

A.D.

7. The temple adorned with precious marbles by Alexander Severus . . . . between 222 and 235
8. Valerius Maximus states that a bank was begun and finished, on the right side of the market, by throwing things into the sea, on account of the incursion of the storm 230
9. Pozzuoli ruined by Alaric 456
10. Eruption of Vesuvius 472
11. ———— 542
12. Pozzuoli ruined by Genseric 545
13. Eruption of Vesuvius 685
14. Pozzuoli ruined by Romualdo II. Duke of Benevento . . 715
15. Eruption of Vesuvius 993
16. ———— 1036
17. ———— 1043
18. ———— 1138
19. ———— 1139
20. Eruption of Solfatara 1198
21. Monte Epomeo, Ischia, active 1302
22. Eruption of Vesuvius 1306
23. Earthquake 1488
24. Eruption of Vesuvius 1500
25. Grant to the University of Pozzuoli of the land drying up from the sea 1503
26. Grant to the city of ground dried up (desiccatum) . . 1511
27. Monte Nuovo, Eruption of 1538
28. Eruption of Vesuvius 1631
29. ———— 1660
30. ———— 1682
31. ———— 1692
32. ———— 1701
33. ———— 1704
34. ———— 1712
35. ———— 1717
36. ———— 1730
37. ———— 1737
38. Temple of Serapis dug out 1750
39. Eruption of Vesuvius 1751
40. ———— 1754


Darling Range.
Granite
10 Miles Horizontal
Trap Dykes.
Upper
Tertiary
Lower
Granite
W
Upper Shales
2 Sydney Sandstone
4 Coal Measures
5 Lower Sandstones
Georges River.
3 Miles.
2
Appin
E
Campbell Town

[illegible]


E
10.
Chobham Place
St Georges Hill.


E
10.
Chobham Place
St Georges Hill.

Fig. 2 A. *Dictyopteris obliqua* natural size.
2 B. A leaflet of the same, magnified.

PLATE XXII.

Fig. 1 A. *Neuropteris rarinervis*, natural size.
1 B. Leaflets of the same, magnified.

PLATE XXIII.

Fig. 1 A. *Odontopteris subcuneata*, natural size,
1 B. A leaflet of the same, magnified.
2 A. *Pecopteris tænioptcroides*, natural size.
2 B. Part of the same, magnified.
3 A. *Sphenophyllum erosum*, natural size.
3 B. A leaf of the same, magnified.

PLATE XXIV.

Fig. 1. *Lepidodendron ? tumidum*, natural size.
2 A. *Lepidodendron binerve*, natural size.
2 B. Another specimen of the same, with young cones, natural size.
2 C. Leaves of the same, magnified.

THE

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1847.

PART II. MISCELLANEOUS.

on the meteoric iron of Pallas, well-known and repeatedly analysed by distinguished chemists, and in reality I have found in it both copper and arsenic; also in the Mexican meteoric iron of Yuanhuitlan, near to Oaxaca, brought home by my colleague M. Sommerschu, principal engineer of mines; in a meteoric iron from Tennessee, described by M. Troost in Silliman's Journal; and finally in a fragment of the great mass of meteoric iron deposited in the Museum of Natural History of Yale College in Connecticut. Consequently it is not only at the surface of the earth that iron is mixed with copper and arsenic, but also in the solid portions of other celestial bodies.

"The results of these researches are highly deserving of attention. In regard to the ores of iron, they particularly claim that of the worker in iron: in regard to mineral waters, they may explain certain peculiar effects of celebrated springs: finally, in discovering these two poisonous minerals in earthy substances, in clays and cultivated soils, they have a manifest interest for all those persons who occupy themselves with researches in medical jurisprudence; and for the interests of humanity and justice they are altogether indispensable."

J. N.

THE END.

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